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# Mixed-Device and Mobile Web Surveys

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## Abstract

For many years, web surveys have already been the most frequently used survey mode in Germany and elsewhere (ADM, 2018; ESOMAR, 2018). Moreover, respondents increasingly use mobile devices, especially smartphones (or less often tablets), to access the Internet and participate in surveys. Because of those new developments within the Internet usage landscape, this contribution expands an earlier Survey Guideline on web surveys (Bandilla, 2015) by addressing methodological advantages and disadvantages of mixed-device as well as mobile web surveys. Moreover, it provides best practice advice on the implementation of such surveys in the areas of sampling, questionnaire design, paradata collection, and software solutions.

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# 1. What are mixed-device and mobile web surveys?

With the popularization of the Internet, web surveys became increasingly widespread due to low costs, short response times, and the advantages of digital data collection such as filter patterns, visual and experimental designs (Silber, Daikeler, Weidner, & Bosnjak, 2018). In the early years of web survey research, desktop computers and later also laptops were the only ways to fill out questionnaires on the Internet. Nowadays, a broad variety of Internet-enabled devices that are web browser capable are available, and Internet usage is partially shifting toward mobile devices (Poushter, 2016). This development affects all parts of society, but particularly younger and higher educated populations (de Bruijne & Wijnant, 2013; Weiß, Silber, Struminskaya, & Durrant, 2019). While the use of mobile devices such as smart-TVs, smartwatches, smartphones, and tablets is already very common for most Internet activities, desktop computers are, however, still the most prominent devices when it comes to survey response (Silber, Daikeler, et al., 2018). Since Internet coverage constantly increases, mobile devices enable respondents to access the Internet at any location and thus allow them to answer questionnaires independent of time and location, e.g., in a train or at an airport (Couper, Antoun, & Mavletova, 2017).

In most surveys, respondents are free to choose which device they want to use to answer a survey. These surveys are called mixed-device surveys. In other surveys, respondents of mobile surveys are forced to answer the questionnaire on a mobile phone, e.g., because researchers want to use an app to track respondents. The usage of smartphones and various other devices among survey respondents leads to a variety of screen sizes, data entry methods, operating systems, and web browsers that influence how a web survey questionnaire is displayed on the respective devices and how respondents complete the questionnaire. This is a major challenge for survey designers, as the goal is to enable all respondents, no matter on which device they answer, to achieve a pleasant and preferably similar survey experience. Thus, survey designers need to rethink the design conventions for online surveys that are based on PC (Antoun & Cernat, 2019).

Essentially, there are three options for survey designers - stick to the nonadaptive design optimized for PCs, following a unified design approach (Dillman, 2000), or choosing a responsive survey design. Sticking to the nonadaptive design, which is displayed similar on every device and based on classic web questionnaires is not recommended and may lead to issues, like an incompatibility with smartphone browsers. A unified design is usually based on the least flexible device, which is normally the smartphone and displayed in the same way on each device. A responsive design is optimized for each device separately (de Leeuw & Toepoel, 2018). Essentially, the visual design of the questionnaire has a considerable influence on the response behavior and the perceived survey burden of respondents. An optimized questionnaire usually results in a less burdensome answering process, which decreases the likelihood of drop-outs (Mavletova & Couper, 2015) and unwanted response behavior such as straightlining (Roßmann, Gummer, & Silber, 2018) and speeding (Greszki, Meyer, & Schoen, 2014). For a comprehensive overview of mobile web surveys, see Couper et al. (2017). Another possibility is to specify a device and restrict participation in the web survey to the use of this device. This allows survey designers to implement specific designs and features that are suitable for one device but not for others. An example can be the use of smartphones to collect additional data with the sensors of the phone. However, it should be recognized that this is likely to increase unit non-response as device switching is an uncommon task and associated with considerable effort for the respondents (Keusch & Yan, 2017). When receiving the invitation respondents might open the link to the questionnaire immediately on their smartphone. However, if participation on a smartphone is not allowed, not everyone will follow the link again later when having actually access to a desktop computer or laptop.

## 2. Advantages of mixed-device and mobile web surveys

One key advantage of mixed-device web surveys is the coverage of mobile devices, such as smartphones and tablets, which are used by an increasing part of the population and which have specific advantages for survey researchers compared to other devices. Specifically, mobile devices allow respondents to answer questionnaires nearly at any location and time, which lowers those restrictions and by that also survey burden (Couper et al., 2017). Furthermore, particularly smartphones are often carried on the body and are, therefore, permanently available, which makes them ideal tools for additional non-survey data collections (e.g., GPS tracking data, pictures of bought groceries).

Additionally, smartphones enable new ways of recruiting a sample for web surveys by using an additional mode for contacting respondents. While most desktop computers, laptops, and tablets are limited to a landline Internet connection, smartphones are equipped with SIM cards and can be directly contacted via a unique mobile phone number. Therefore, researches have the possibility to create a RDD sample, consisting of mobile numbers to recruit respondents (Couper et al., 2017; Häder, 2015). To reduce the number of unused numbers, an HLR lookup procedure can be used (Kunz & Fuchs, 2012; Sand, 2017). Alternatively, the numbers can also be contacted by a text message including a link to a survey. [1] However, previous studies using this approach received low response rates (Beuthner, Sand, & Silber, 2019; Couper et al., 2017).

The inclusion of mobile devices into the device mix for web surveys can increase the coverage and makes it easier to survey specific populations. For example, refugees are nearly exclusively reachable via mobile devices (Keusch, Leonard, Sajons, & Steiner, 2019). Generally, respondents with access to a mobile device with Internet access are likely to differ from those without a mobile device or mobile Internet access in factors like age, education, and income. This can be explained by different Internet penetration rates and device preferences (Bosnjak, Bauer, & Weyandt, 2018). Similarly, those respondents who prefer to use their mobile device to answer a survey may differ from those preferring a desktop computer. These biases in device use and preference can lead to undercoverage when conducting mobile surveys. Sampling the users of an app is another targeted option to reach specific sample populations (e.g., respondents who suffer from diabetes through special apps). See also section 4.2.

Another important advantage of mixed-device and mobile surveys is the ability of smartphones and tablets to deliver additional data (Link et al., 2014). The collection of data via a mobile application (app), which has to be downloaded and installed on the smartphone or tablet, is a possibility to generate additional data. Apps can be used to track respondents' behavior, allow them to take and upload pictures, take notes, or create voice recordings. Such measures can help to avoid retrospective questions and, therefore, lower the demanded cognitive effort and increase data quality. An app can also be helpful when conducting a panel survey. It can be seen as an easy and reliable way to contact respondents when dispatching questionnaires.

Furthermore, mobile devices like smartphones and tablets have built-in sensors to measure acceleration, brightness, geo-position, and additional characteristics. Those can be used to gather passive data and track movements, positions, and environmental conditions (Link et al., 2014; Höhne & Schlosser, 2019). Finally, in an age of decreasing response rates in Germany and many other countries (de Leeuw, Hox, & Luiten, 2018), it is recommendable to allow respondents to use the device of their choice. Doing so will help lowering survey burden and, therefore, increase response rates.

An additional noteworthy general advantage of all kinds of web surveys is that researchers can collect a vast amount of paradata with the help of JavaScript-based scripts running in the background. Those scripts are simple to implement, do not influence the performance, and do not

[1] This might not be possible in every country since in some countries text messages can only be send out if a person has agreed previously that he or she can be contacted via a text message by the research organization. In Germany, it is currently possible for purely scientific surveys only. However, this may change in the future.

have an impact on the respondent. They deliver data such as screen size, screen resolution, interruptions, browser activity, mouse clicks or finger tabs, and response times. Some of these measures can only be collected if they apply to the device (e.g. finger tabs can only be collected when a touchscreen is used). A deeper discussion on the collection of paradata can be found in section 4.3.

## 3. Disadvantages of mixed-device and mobile web surveys

Besides many advantages, mixed-device and mobile web surveys also come with downsides. Web questionnaires, as well as the software they are created with, are originally focused to be displayed on desktop computers. Therefore, optimization for mobile devices such as smartphones and tablets is rather difficult because it may often require the development and implementation of non-standard solutions. The questionnaire design on non-desktop devices is related to a variety of issues. As particularly smartphone screens are smaller, for instance, large grid questions cannot be displayed on a single screen, and have to be split into multiple screens, font size is smaller and so questions might be difficult to read, and open-ended questions are more difficult to answer and burdensome with a digital keyboard (McClain, Crawford, & Dugan, 2012; Peterson, Mechling, LaFrance, Swinehart, & Ham, 2013).

Furthermore, the operating system and screen size of mobile devices vary considerably, so that targeted optimization for all devices is complex and challenging. Some software solutions offer responsive designs, which automatically adapt to the web questionnaire. While this helps to handle design issues in an automated manner and requires a low amount of effort, it can lead to different visual presentations that need to be tested and eventually also controlled in the data analyses. Such differences can lead to a different measurement error depending on the device. Consequently, the comparability of results may suffer from different questionnaire versions (i.e., mobile-optimized vs. not optimized; see Figures 1 and 2 for an example how a grid question is displayed differently on a smartphone screen depending on the visual design choice).

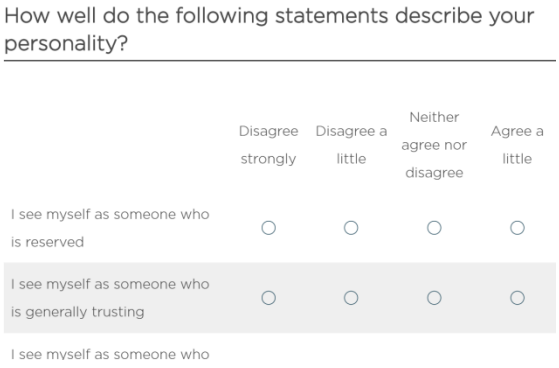


*Figure 1:* Non-optimized grid question displayed on a smartphone screen in a unified survey design

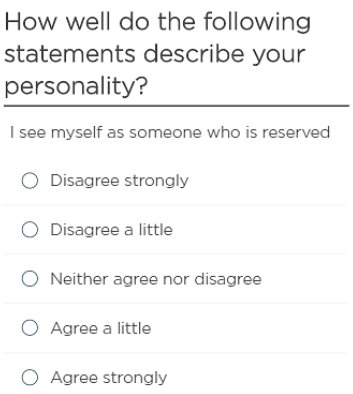


*Figure 2:* Optimized grid question displayed on a smartphone screen in a responsive survey design

Many devices run old operating systems such as old versions of Android, as well as outdated browser versions, which can prevent a correct presentation of the questionnaire. As smartphones and tablets are heavily used for communication and the usage of social media, respondents could be easily distracted by incoming messages and notifications while answering a survey. All those factors can increase survey burden and might lead to satisficing response behavior, item non-

response, and drop-outs (Couper et al., 2017). Therefore, researchers are recommended to design shorter mobile questionnaires, for example by avoiding multi-item pages, text inputs, or by using a split-questionnaire design (Antoun & Cernat, 2019.).

Furthermore, the usage of mobile Internet to answer surveys on the go can lead to connectivity issues when sending or loading questionnaire pages, dependent on the quality of the Internet connection (Mavletova & Couper, 2016). Further, other distractions and environmental influences could affect the response behavior when respondents are in an open environment instead of their home. Finally, as for all Internet-based surveys, there is no way to use a probability sampling approach for the general population without using another contact mode, which poses a yet unsolved issue for all web surveys including mixed-device and mobile web surveys. More information about sampling can be found in section 4.2.

# 4. Aspects of implementations and resources

## 4.1. Questionnaire design

Questionnaire designers are confronted with several challenges when creating a mixed-device web survey. The probably best way to implement a mixed-device web survey is to use a responsive design that optimizes questionnaire layouts for respective devices. As responsive design options are implemented in most standard web survey software tools, this solution needs little effort and is reliable for most devices and browsers. However, responsive design options can lead to unintended and unobserved differences in the presentation between the devices, and, therefore, influence the comparability of survey data. Another feasible way is to develop the questionnaire following the idea of a unified design by using, for instance, a mobile-first design. In such, all questions are optimized for the least flexible device, which is in the case of mixed-device web surveys a mobile device. Consequentially, all questions are displayed in the same way on all devices. This solution cannot be implemented automatically and may require programming skills, but is recommended for mobile surveys.

For mixed-device and mobile web surveys, the chosen font and other aspects of the visual design should be clear and easy to read and understand to minimize the cognitive effort necessary by the respondents to comprehend and answer the survey questions. Font sizes should be adapted to the screen size, to avoid the necessity of scrolling and zooming, which would otherwise increase the survey burden. Certain kinds of questions are also critical when designing mixed-device web surveys. Questions using drop-down selections, moving elements or slide controls should be avoided because they are difficult to answer using a touch screen. If (large) grid question batteries, which display multiple items at once, cannot be avoided, they should be split into either smaller grids or single item questions to avoid forcing respondents to scroll (Couper et al., 2017). Similarly, the number of open-ended questions should be minimized, as typing on digital keyboards is inconvenient compared to physical ones. Voice recordings can be an interesting substitute, but they require transcription (Revilla, Couper, & Ochoa, 2018a).

Furthermore, survey length is an important issue in mixed-device and mobile web surveys, so that questionnaires should be relatively short. Drop-out rates may rise with increasing questionnaire length, especially on smartphones (Couper et al., 2017). Therefore, specific survey design options such as split questionnaire designs should be taken into account to reduce survey length (Toepoel & Lugtig, 2018).

In summary, questionnaires should be optimized to the specifics of respective devices to minimize the necessary amount of horizontal scrolling and zooming, as this massively increases survey burden and, leads to more satisficing and item non-response (Couper et al., 2017). Furthermore, the questionnaire should be tested on a variety of different devices and in different web browsers to

avoid issues arising from the display on respective devices. This can be done effectively by emulating certain devices within a browser.

## 4.2. Sampling and survey design

Sampling is one of the major issues for web surveys in general as there is no register of all email addresses of the German population from which a random sample can be drawn. A good overview of sampling issues in web survey research is provided in the previous Survey Guideline on web surveys (Bandilla, 2015). All sampling options available to web surveys are also available for mixed-device and mobile web surveys. While non-probability samples can usually be collected without much effort, probability-based mixed-device web surveys provide several challenges for researchers.

Non-probability web samples include convenience samples such as intercept surveys done with pop-ups or by posting a survey link on Internet forums, in apps, on social media platforms (Pötzschke & Braun, 2017), or using river sampling (Rivers, 2007). The distribution of the questionnaire by QR codes in public or on printed forms is another option and particularly relevant for customer surveys and market research institutes. Such surveys are based on unrestricted self-selection. Quota samples can be provided by volunteer opt-in panels, which are usually administered by market research organizations (Couper, 2000).

A possibility for drawing a probability-based web sample is using a given email list as a sampling frame. This is usually used for specific populations such as students of a specific university and needs all email addresses as a prerequisite. Another option is to use another contact mode than the web mode. For instance, mobile phone numbers can be generated by using an RDD sampling procedure, and respondents can then be contacted by text message (Beuthner et al., 2019).

Many academic online panels such as the German Internet Panel (Blom, Gathmann, & Krieger, 2015) or also mixed-mode panels that include Internet users such as the GESIS Panel (Bosnjak, et al., 2018) are based on contact strategies that use alternative contact modes, for example by recruiting respondents out of large probability samples.

## 4.3. Paradata, passive data, data linkage, and privacy

The opportunity to collect a great variety of paradata is one of the main advantages of web surveys. This can be done on nearly any kind of device in a mixed-device web survey, which allows running JavaScript applications in the browser used. Common paradata scripts can collect a variety of variables such as response time, screen size, and resolution or finger taps. One of the most recent scripts was written by Schlosser & Höhne (2018). Another option is the script written by Kaczmirek (2014). While most paradata can be collected on any device, mobile devices have advantages in providing passive data such as movement and gps data (Link et al., 2014). This, however, usually requires the use of a mobile application (see section 4.4). In general, it should be pointed out that paradata and passive data can drastically increase the size of the dataset so that researchers should carefully consider which data they need before collecting it.

From an ethical and legal perspective, it is essential that researchers inform respondents about the data collected. Other kinds of additional data such as data from social media or sensor data, are legally bound to respondents' informed consent and need their active cooperation (ESOMAR, 2018). Consent rates will differ between different data types and some respondents will fail to successfully complete the linkage procedure (Beuthner et al., 2018; Daikeler, Gauly, & Rosenthal, forthcoming; Revilla, Couper, & Ochoa, 2018b; Silber, Weiß, Keusch, Beuthner, & Schröder, 2018). Therefore, all information regarding data protection laws, the data collected, and the linkage procedure should be accurate, clear, understandable, and well-tested.

### 4.4. Software solutions

There is a variety of feasible software tools to create browser-based online questionnaires; most of them are equipped with a responsive design option. Viable options are Qualtrics, LimeSurvey, SurveyMonkey, Unipark by Questback, and others (Herzing, 2019). Most of these software producers offer free and paid options. Researchers should have a close look to find the best software for their needs. Besides price, differences lie in available question types, possibilities of influencing the layouts, fieldwork monitoring tools, compatible browsers, devices, operating systems and other features (Kaczmirek, 2017). With regard to mixed-device surveys the adaptive layout features are of special interest.

An alternative to browser-based surveys are survey applications, which have to be installed on the device by the respondent (Callegaro, 2013). According to Macer (2012), conducting a web survey via an app is a safer way to present a survey in a similar way for all respondents. Moreover, it does not need a permanent Internet connection, and can be a way for researchers to communicate with respondents (e.g. through a built-in messaging feature). However, such applications can be cost-intensive as they may need specific software developments and may increase the survey burden since they need to be downloaded and installed by respondents before the survey can be conducted.

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